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ABSTRACT

The article discusses the use of the Structure of Intellect (SOI) model as a basis for developing thinking abilities in a variety of curriculum areas: (1) the integration of subject matter areas and SOI operations; (2) thematic lessons that sequence specific cells of the SOI model; (3) directed teaching lessons to develop student awareness of their own thinking processes; (4) strategies that foster student attitudes conducive to the use of divergent thinking; and (5) application of SOI-based thinking abilities to problem solving. Sample curriculum activities are included as illustrations. (Author/JW)

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APPLYING THE S.O.I. MODEL TO CURRICULUM DEVELOPMENT

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Abstract

As our national commitment to gifted education varies with political considerations, it is essential that educators develop effective curricular processes that enhance each student's ability to think and solve problems. Work in the following areas can use the S.O.I. model as a basis for developing greater thinking abilities in a variety of curriculum: (1) the integration of subject matter areas and S.O.I. operations; (2) thematic lessons that sequence specific cells of the model; (3) directed teaching lessons to develop student awareness of their thinking using an S.O.I. base; (4) a synthesis of Divergent Production and attitudes that support a variety of contents and products in that operation; (5) application of S.O.I. based thinking abilities to problem solving. Gifted students need more than piecemeal activities or disjointed units. It is hoped that by encouraging greater scope and sequence through the S.O.I. model that students will receive more thorough quality instruction.

Educators in gifted education, and other areas of special education have long attempted to increase the ability of their students to "reason" and to develop "higher levels of thinking." The questions become complex. How might educators enhance the thinking of their students? How does enhancing thinking affect learning? How can a developmental course of thinking be applied to subject matter? When a student learns to understand thinking, how might s/he experience a variety of thinking and how might that variety be applied to valid problem solving techniques?

The importance of learning to think has become a recent focus of education in the United States. Considering the vast resources for creating a better world that lie within the human mind, educators are now seeing a large quantity of "programs" intended to teach students "thinking skills."

Knowledge of Structure of Intellect presents a valid model for analyzing and comparing various thinking programs.. For example, some programs are entitled "Critical Thinking," which involve

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students solely in the operations of Convergent Production and Evaluation and which are often limited to semantic content. In addition to these limitations, many programs deal specifically with the less complex products of units, classes and relations. By using elaborate terminology such as "using analogies" or "making inferences," educators often believe they are really teaching students to think more effectively. By perceiving the S.O.I model as "too complex" or "too time consuming" for a classroom setting, educators limit the abilities and expectations of their students.

Many educational systems have tied their thinking programs to the taxonomic model of Benjamin Bloom (Bloom, 1956). This procedure offers thinking as a hierarchy of steps through which students must progress to learn to think. A student is required to begin at the "lower levels of thinking" and progress through assigned activities until they reach the "higher levels of thinking." Using this taxonomy with students, especially gifted individuals, is highly questionable. In the first place, Bloom's Taxonomy was devised with limited empirical research to instruct teachers on how to write behavioral objectives for their lessons. The taxonomy created a means to introduce teachers to different levels of thinking and addressed these kinds of thinking into predetermined subject matter areas. These intended procedures did indeed occur, but educators began to teach these objectives as thinking skills in and of themselves.

Secondly, Bloom's Taxonomy worked well to program students through a series of tasks. This allowed educators to have students work through given thinking/subject matter activities in a rigidly sequenced manner with little concern as to how much students understood their thinking or how to apply it to other situations.

During the early 1970's, two educators in the East Whittier City School District in California discerned a need to help gifted students learn to think more accurately and effectively. Eleanor Manning and Marilyn Brown developed a federal project to increase Divergent Production in gifted students. After a discussion with Dr. J.P. Guilford, Structure of Intellect was determined as a more open, creative model to base the project on. At this time, Dr. Guilford pointed out that the taxonomy was included and broadened by the S.O.I. model. It later became quite obvious to the two educators involved that indeed S.O.I. offered far more variety and intellectual exercise that the taxonomy.

As a member of the staff working on the federal project (Creative Prescriptions Unlimited, 1974), it became obvious to the author that the S.O.I. model was an expansive vehicle for increasing the thinking of gifted students. Under the guidance and expertise of Dr. Mary Meeker, four resource teachers were trained in the S.OI. model. It then became the responsibility of the teachers to plan, implement and write-up lessons based on the model. During the four-year implementation of this program, gifted students were found to increase their Divergent Production abilities significantly, with the exception of grade 7 students where limited progress was made.

By 1978, local interest in the federal S.O.I. program diminished locally, but teaching students to think was becoming a major focus for education in other areas of the United States. It was at this time that a group of educators involved in the federal project in East Whittier became concerned that the teaching of thinking might become rigid and dull...and that using S.O.I. as a curriculum for thinking might be overlooked. The author, and these educators, began developing materials that focus on various processes of the S.O.I. while integrating them with a subject matter theme. These materials were supported by strategies of teaching to broaden each operation or specific cell to allow greater application by a student into other areas. With this strategy in mind, the author has used the S.O.I. model for lending greater scope and sequence to curriculum development in her classes for teachers. With training, educators are beginning to understand how vast the variety of thinking S.O.I. allows and how it supports the learning of subject matter areas.

The S.O.I. Model and Learning

It has long been accepted that learning can be increased by working on the specific S.O.I. cells that support certain skills. By diagnosing a student's abilities, educators can address and remediate for a specific learning need.

During the federal project educators also learned that students became involved with and excited about their thinking with S.O.I. Students constantly wanted more of the activities created by the teachers and asked to learn more about producing ideas. This response gave the educators the idea of presenting a variety of operations to students, along with inventive projects on which they could work. The result was that advanced gifted students who had a great deal of knowledge were encouraged to use a greater degree of their divergent abilities, to discuss and understand what these abilities included and then apply these abilities to solving problems. Other gifted students who remained disinterested in learning in the classroom awoke to the possibilities of their minds and the ideas they could create. More confidence in their thinking led to more interest in learning and greater achievement.

Following the results of this project, the idea of helping students become aware of their thinking and how to use it effectively became a goal for developing materials based on the S.O.I. model.

Applying the S.O.I. Model to Curriculum

Some teachers in gifted education have had greater training and experience in extending the thinking abilities of their students. More often, gifted students are integrated into the regular classroom and work with teachers who have less knowledge of thinking and who are stressed with dealing with all kinds of students.

For these reasons, it is important to introduce students to a variety of s.o.i. operations gradually. By incorporating various operations into a theme of study, students are able to experience the kind of general thinking represented in the activity and have a consistent presentation of the subject matter. Students have become intrigued and excited about learning science content when they have an unusual thinking activity as part of the lesson. Each thinking lesson has a brief subject matter background and then proceeds with an activity based on a particular operation as shown in Figure 1.

By presenting a variety of operations to students in a content area, students soon realize that many kinds of thinking are necessary to learning(Guilford, 1977). Students learn that some operations are easier for certain individuals, while the same operations are easy for others. Teachers begin to understand that gifted students are not always "thoughtful" individuals and are not "good" at everything. Teachers also may find that perhaps a less successful student can do well in some of the operations less used in academic work. These realizations help build a student's self-esteem and creates a new dedication to learning. Teachers have commented on the fact that their passive learners have become more involved in a subject and want to know more.

As teachers and students become more familiar with S.O.I. operations, more specific lessons based on the model can be used. Rather than using operations alone, each operation is divided into contents and products. As a developmental program in thinking, each student activity is begun with a lesson in figural information (usually visual or auditory). This kind of activity is followed by lessons in symbolic information, then more activities in semantic content. At the same time, students deal first with units and classes; they then work on relations and systems, finally reaching the more complex and creative products of transformations and implications. These thinking activities are sequenced under a unifying theme so that both teachers and students see how the S.O.I. model influences learning. Activities must remain interesting and motivating as shown in Figure 2.

Research has shown that students increase their thinking significantly if they also discuss how they approached the activity and the kinds of thinking they applied (Sternberg, 1985). In building on this idea, teachers have been encouraged to ask students questions that lead into a lesson and deal with the kinds of thinking they will do. At the end of the lesson teachers also ask questions about how students feel they thought and the naming of the kinds of thinking they did. A step further asks teachers to develop questions that help students apply the thinking they used to other areas, as in Figure 3.

In teaching educators the strategies that make students "think about their thinking," the author has found that both teachers and students develop more awareness of their thinking and better ways to use it. The ability to think becomes valued to a much greater degree than before. Each operation is presented to teachers, and thus their students in a develpmental way, using the contents and products as previously mentioned. This gives the learner the idea that no one

operation is more important than the other, but that the way the products are used and the modes by which the contents are presented, affect the learning and learner to as great a degree. All of these aspects of S.O.I. are essential for better thinking and students realize that they no longer need to say "I'm not good at this." By experiencing the thinking that supports learning they learn to build and use that thinking in a more effective way. So much of a person's thinking lies in his/her perception of a thinking ability that as students work on an aspect of S.O.I. their perceptions change and they are willing to admit to thinking more.

Teachers have expressed the benefits they receive from teaching students to think about their thinking. As the lessons progress they find that reluctant or unmotivated students become involved. On the other hand, high achieving students become more interested in how they think than about acquiring knowledge.

After years of working with students and teachers in this kind of S.O.I.-based curriculum, the author is now beginning to integrate Divergent Production with attitudes that will help students produce more creatively and will expand their desire to solve problems more divergently.

By using lessons as shown in Figure 4, students are discussing how their attitudes increase or inhibit their ability to think divergently. Teachers are given suggestions for bringing out the attitudes, as well as thinking, that will increase student divergence. Specific strategies are presented to increase student awareness and application of the Divergent Production activities. Directed lesson plans as shown in Figure 5 give teachers suggestions for the processes that support a synthesis of thinking and attitudes. As Divergent Production is applied to problem solving, Convergent Production and Evaluation and then incorporated to complement the problem solving process, as shown in Figure 6.

It is evident that a good deal more research must be done in the area of providing gifted students with directed S.O.I.-based lessons to nurture their attitudes and productivity in thinking. Based upon the field-testing of two hundred eighty-five teachers over the past five years, the teachers have found that the given strategies have produced a greater ability to think efficiently and an increased willingness to think on the part of their gifted students. Teachers have also found that their own attitudes toward "achieving" and "non-achieving" gifted students changing. They are coming to realize that teachers may overlook the abilities of their less-interested students, while overestimating the ability to think in their faster students. This conclusion presents some encouragement to educators who believe in educating students, rather than programming them through materials.

CONCLUDING COMMENTS

A systematic, developmental program using the S.O.I. model as its base is an effective means of increasing both teacher and student awareness of the potential of the human mind. But more is needed.

We also need to consider individual needs and integrate specific S.O.I. processes into the curricular base. These individualized programs must address not only abilities, but the influences of cultural backgrounds in teaching studes (Meeker, 1978). Those of us who not only believe in, but also apply the procedures of the S.O.I. model must realized the scope and variety of application this model offers to education. The more one uses the model, the more one perceives its great potential and expansion in the field of gifted education (and for education in general). It seems that the priority on thinking is a valid step and should become a goal that must continue to be supported for many years to come. It is an essential part of helping future generations develop into the thoughtful individuals we need for our global survival.

MEMORY

Here's a game to help you have a better memory for relationships. First - fold the paper on the dotted line. Only the top part should show. Now study the silly names for 2 minutes. Think about how you might remember them. Look for RELATIONSHIPS (re-LAY-shun-ships) -- how do the names go together?

ROACH HOTEL
MINDA MOTH
BART BEETLE
BARNEY BUTTERFLY
WASP PARTY
OLIVE ANT
CEDRIC MAGGOT
MYRNA CRICKET

Your teacher will tell you when 2 minutes have passed.

fold here

Now look at list A. Match the names with those in list B that you remember. Write the correct first name next to the insect as you remember seeing it above.

List A		List B
MYRNA	_____	MAGGOT
ROACH	_____	CRICKET
MINDA	_____	BUTTERFLY
OLIVE	_____	ANT
WASP	_____	BEETLE
BART	_____	HOTEL
BARNEY	_____	PARTY
CEDRIC	_____	MOTH

NOW -- CHECK your work. Compare what you wrote with the TOP PART of the page.

How well did you do? Put the total number you remembered correctly here.....

Figure 1: S.O.I. operation integrated into subject matter.

(NSU)

The Sumerian number system made record keeping easier - and brought us closer to a system of mathematics.

The Sumerian record keepers soon worked out a better system to count quantities than making a mark for each thing. Using the ten fingers (and toes) as a basis, they first developed a number system based on TEN (decimal system). They later used an alternate system based on SIXTY (sexagesimal system). When this counting system was put on clay tablets with the wedge-pointed stylus, new marks began to be used and a set of symbols was finally created. These new cuneiform marks were easier to record as the amount of Sumerian bookkeeping increased.

Look at the chart of the Sumerian decimal system shown below. Then use this information to draw the correct symbol to fit the directions given to the right. Use a separate piece of paper.

1 =	𒁹	11 =	𒌋𒁹
2 =	𒁹𒁹	20 =	𒎙
4 =	𒐈	40 =	𒎙𒎙
6 =	𒐉	50 =	𒈫
10 =	𒌋	60 =	𒁹

Directions: Using cuneiform writing, draw the symbol for the number needed to fit the descriptions given below.

A. Draw the symbol for the numeral that would come immediately after 𒌋𒁹

B. Draw the symbol for the numeral that would be immediately before 𒌋

C. Draw the Sumerian symbol that would come just before 𒁹

D. Draw the symbol that would come directly after 𒁹𒌋 𒐉

E. Draw the symbol that would be just before 𒌋𒌋𒌋 𒐈

F. Draw the symbol right after 𒁹𒌋𒌋𒌋 𒐈

G. Draw the symbol just before 𒌋 𒁹𒁹

HIGHER ACHIEVEMENT:

1. Compare your answers to the ones your teacher gives you.
2. Based on this information, try to predict what the following Sumerian numbers might be by drawing them on another paper.
   - Draw what you think 100 might look like.
   - Draw what 1000 might look like.
3. Check with the given answers and see how close your predictions were.

   a. Which parts of the numbers were easy to predict? _____

   b. Which parts were new and something you did not know before? _____

Figure 2: Specific S.O.I. activity based on subject matter.

TEACHER PLANS AND INFORMATION - MEMORY

MEMORY (M) is storage and retrieval/retention and storage/with some degree of availability of information in the same form as it was when it was committed to storage. It is responding to some clues in connection with which it was learned.

PAGES 10-11:

PURPOSE: To practice short term memorizing and remembering figures - objects.

MOTIVATION/ACTIVITY: Tell your students that scientists say our memory plays tricks on us. We remember what is EXCITING - FUN - SCARY. We forget things we do not like or do not want to do. SAY: Most of the learning we do depends on our remembering things. Give students page 10.

DISCUSSION/EVALUATION: SAY: What are some ways we might remember the insects on this page? (Look for relationships, similarities, implications, group them, classify them.) Each of us must choose the way we should remember -- the way which is best for us. Talk about the insects on the page. Ask students to share their observations. (How are they alike or different?) After about 2 minutes, have students put away page 10. Give them page 11. Tell them to see if they can remember which insects were on page 10. Encourage discussion of ways in which they chose to remember. ASK: Did anyone COUNT the number of insects on the study page 10? Could we use any of the ways you chose to remember to study Math or Spelling -- or any of our other subjects? Tell the students to look at the study page and see if they were able to remember correctly. Did seeing the words distract them? Was it confusing to see so many insects on the page? EXTENDER for older students: Work on this page again. This time add the names of the 5 insects to the bottom of the study page. Use the Answer Page as the study page this time. Students are to study names and insects and then go to the study page and write the correct name under the insect it identifies. This EXTENDER takes students' thinking to a still higher level: semantics.

PAGE 12:

PURPOSE: Practice in the skill of remembering relative symbolic information such as words or syllables.

MOTIVATION/ACTIVITY: Put these "nonsense" words on the board: MMRY - RRMBR - TR - STRG - RCLL. After a minute erase the words. Have students write the ones they remember. SAY: Did you find remembering the "nonsense" words easy or difficult? (Why?) (no vowels?) What system did you use to try to remember? (Encourage sharing -- especially from those who remembered all of them.) Put these words on the board: "TRY - STRONG - RECALL - MEMORY - REMEMBER". Give them a minute to study the words and then erase them. SAY: Write the words you remember. ASK: Was it easier this time -- or more difficult? Did any student fit in vowels the 1st time? If not, SAY: What if you were to try to relate the nonsense words you did first to actual words. Might that have helped? (That's another way to remember -- make words or connect them to possible words.) Give students page 12. Read directions together. SAY: You have seen the nonsense words with their vowels on another page.

DISCUSSION/EVALUATION: Have students check their work after they have had a chance to circle what they remember. Encourage discussion about frustrations - feelings - easier words - more difficult, etc.

PAGE 13:

PURPOSE: Practice in the auditory skill of remembering words, class properties and connections between symbolic information - words and numbers.

MOTIVATION/ACTIVITY: Review how we store information we SEE. SAY: This exercise will give you practice in remembering words and numbers you hear. How might learning to remember what we hear help us? (Nothing to write on; college-bound listen to lectures; phone numbers in emergencies, etc.) Put these words and lines on the board: _____ cats, _____ dogs, _____ rabbits, _____ chickens. SAY: I'm going to say some numbers that will go with each of the animals. Listen carefully and see if you can remember the numbers I say and to which animal the numbers belong. 16 dogs, 23 rabbits, 35 chickens,

Figure 3: Teacher lesson plans.

CREATORS COURAGEOUS

Courage is an essential part of creative intelligence. In spite of the many people who "give up" on an idea, or on solving problems, there are members of the CREATIVE MINORITY who still strive to make things better.

Jean-Francois Champollion was born during the French Revolution. As the son of a bookseller, he loved books and taught himself to read at the age of five. Jean absorbed all he could about ancient Egypt and Greece, having the courage to seek out people who could add to his knowledge. Jean saw Egyptian artifacts brought back by Napoleon's scholars and was fascinated by the strange signs he found on some of them. Jean vowed that someday he would be able to read these signs, called hieroglyphics. His COURAGE kept this dream alive as he spent years studying ancient languages to learn more to help him decode Egyptian hieroglyphics.

COURAGE KEEPS OUR MINDS OPEN AND FLEXIBLE!

THINK with greater FLEXIBILITY as you consider how to make things BETTER.

() IMAGINE that a common trash can became the size of a cup. How might this IMPROVE the trash can?

- Put your ideas on another piece of paper.

() VISUALIZE a trash can the size of a truck. How might this make a trash can better?

- ADD more ideas to your paper.

() CONSIDER changing the design of a trash can. What <u>other</u> shapes would make it more convenient to use?

<u>COURAGEOUS CHOICES</u>

- Which ideas on your paper ACTUALLY IMPROVE a trash can without causing other problems? Put a "+" mark by these ideas.
- CHOOSE the ideas that <u>best</u> improve a trash can and develop plans for a better trash can <u>from</u> them.
- COURAGEOUSLY create a design and explanation for your new ideas.

Figure 4: Applying attitudes to Divergent Production.

PHASE TWO - ANALYZING CREATIVE THINKING STRATEGIES
(Student pages 17 - 32)

THEME: SHIFTING FEATS

Introduce the theme of this section by discussing how innovative ideas require a VARIETY of creative thinking techniques. POINT OUT that consciously knowing these techniques can help us use them more effectively when we need them.

PAGE 17 - Calculated Steps

LESSON LEAD-IN:

ASK ----- What is the difference between just thinking of ideas and coming up with ideas WHEN THEY ARE NEEDED?
- Why do you have to be willing to take "risks" when you think creatively?
- What do you think the word RISK means?

DISCUSS - The kinds of risks creative thinkers take. (POINT OUT that physical risks may only be acting foolishly or without thinking.)
(EXPLAIN that creativity sometimes requires:
EMOTIONAL RISKS----realizing you may "fail" or be "wrong" the first time your think of an idea
INTELLECTUAL RISKS-understanding you may have to give up past habits of thought and use more effective thinking.)
- How creative thinkers use things provided by nature in new ways, such as; coffee, maple sugar, fruit products.

STUDENT LESSON:

+ DISTRIBUTE copies of page 17 and discuss what the RISK RACER in the cartoon might be. DISCUSS the idea that "calculated steps" is purposely using creativity.
+ REVIEW the background information at the top of the page.
+ EXPLAIN that FLUENT THINKING can be used in many different ways, such as with pictures, numbers, words and ideas.
+ REVIEW the procedures to increase fluency given at the bottom of the page.
+ DISCUSS ways to shut off judgment so greater fluency can take place.
SUGGESTIONS: Think as fast as possible.
Encourage "strange" or "funny" ideas.
+ STUDENT WORK: (I) PAPER should be plentiful.
ENCOURAGE students to write ideas quickly without worrying about spelling or neatness...just so the ideas are readable.

FOLLOW-UP:

GIVE students time to verify that their words are valid.
STUDENTS then put the number of valid words they produced in the blank provided.
DECIDE if it is in the best interest of students to compare their fluency.
(COMPARISONS CAN DISCOURAGE THE LESS FLUENT)

ASK ----- What is the highest number of words you think we might write on the board that rhyme with TIRE? (LIST as many words on the board as the students can give you.)
- How might you think of these words BEFORE you hear them from others?

DISCUSS - Specific suggestions for increasing student fluency.
- How students might apply these suggestions during the next three pages.

CURRICULUM EXTENDER IN LANGUAGE ARTS:

+ Use the word PLANE (or another simple word) as a basic word for fluent thinking.
+ Students then name (or list) all the NOUNS and VERBS that sound like plane.

PAGE 18 - A Faster Type Of Thinking

LESSON LEAD-IN:

ASK ----- How many of you know how to type...even a little?
- Why are typewriters used so much in offices today?
- How might typewriters increase fluent thinking?
- Why were computer keyboards made like a typewriter's keyboard?

DISCUSS - How typewriters can overcome "snags" in fluent thinking. (POINT OUT that Samuel Clemmens typed nonsense words to restart his fluency.)

Figure 5: Directed lessons in Divergent Production.

CHALLENGES

A "PROBLEM" IS A NEW PART OF YOU URGING YOU TO
GET IN TOUCH WITH YOUR FUTURE.

BEFORE we solve a problem, we must discover the REAL problem. It is discouraging to work hard on a solution only to realize that the basic challenge has been overlooked. CREATIVE problem solvers take time to identify the basic or real problem FIRST.

A POLLUTED SITUATION

One of our greatest forms of pollution today is INFORMATION. We have large quantities of information coming at us continually from all directions. We have so much information that it is difficult to sort it out and determine what we really need to know!

PROBLEM DISCOVERY

DISCUSS all the ways we can receive information today.

CONSIDER all the different problems that having too much information might cause.

- < AVOID any judgment of a problem idea.
- < RECORD all the stated problems on a piece of paper.
- < STRETCH your original point of view by seeing the information problem from different or unusual angles. Add them to your list.

REVIEW the list of problems that having too much information might cause.

- < DISCUSS and CLARIFY any problems that are vague or incomplete.
- < ADD any new problem ideas someone may have just had.

CHOOSE one problem from the list to use as your challenge.

- < SELECT a problem that is CRUCIAL for preserving life as we know it.
- < You may want to COMBINE two similar problems into one basic problem.

DISCUSS the basic challenge you have selected. REVIEW the reasons why this particular problem was chosen before proceeding.

- < ARE YOU SURE that this is the most important problem of those listed?

PUT THE PROBLEM YOU HAVE CHOSEN HERE _____

_____

Figure 6: Applying Divergent/Convergent Production and Evaluation to problem solving.

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